LB
3054
C2
D392a

CURR HIST

Alberta

EDUCATION

CHEMISTRY ACHIEVEMENT TEST

This achievement test attempts to cover the major concepts in Chemistry. Some items will be very elementary, while others will present greater difficulty so that the number of items each individual may be able to answer correctly will vary with each grade level. Keep in mind that if the material is unfamiliar, the item may be testing your ability to transfer and analyze information in a different situation. Therefore, it is important that you read each item carefully before attempting it. The diagrams in the test are NOT necessarily drawn to scale.

DIRECTIONS

Use ordinary HB pencil only.

Fill in the information at the top of the answer sheet as directed by the examiner.

Read each item carefully and decide which of the alternatives BEST completes the statement, or answers the question. Locate that item number on the answer sheet and fill in the space that corresponds to the alternative that you have chosen.

Mark your answers according to the instructions and the illustration given at the top of the answer sheet. Avoid placing any marks among the black timing lines along the right-hand margin of the answer sheet.

Mark ONLY ONE answer for each item. If you wish to change an answer, be sure your original choice has been completely erased.

DO NOT put any marks on this test booklet. Scrap paper will be provided.

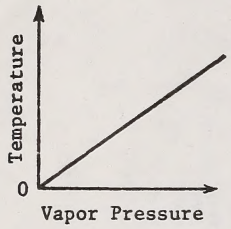
DO NOT bend or fold the answer sheet.

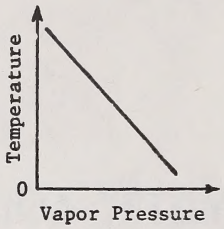
Return complete TEST BOOKLET, ANSWER SHEET, CONSTANTS BOOKLET and PENCIL at the end of the period.

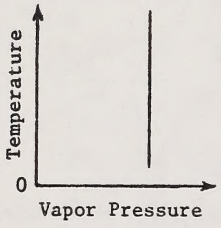
SECTION A

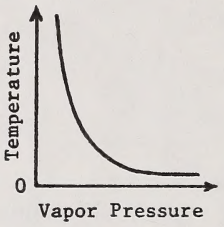
1. The man credited with constructing the periodic table in the form widely accepted today was
   A. Newlands
   B. Mendeleev
   C. Döbereiner
   D. Meyer

2. The graph that approximates the relationship between vapor pressure and temperature is

A.


B.


C.


D.


3. A substance is weighed, heated and then cooled. If the substance now weighs less, a possible explanation is that the substance
   A. gained a negative weight element
   B. was originally a metallic element
   C. originally contained no gaseous material
   D. decomposed into its elements, one of which escaped as a gas

Use the conclusion from a set of experimental data below to answer items 4 and 5.

3.0 moles of A combined with 1.5 moles of B to produce 4.0 moles of C.

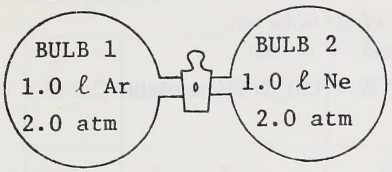
4. The number of molecules of C formed when 15 molecules of B combine with sufficient A would be
   A. 6
   B. 10
   C. 40
   D. 90

5. The number of moles of B needed to combine with 12 moles of A would be
   A. 2.0
   B. 6.0
   C. 8.0
   D. 18

UNIVERSITY LIBRARY
UNIVERSITY OF ALBERTA

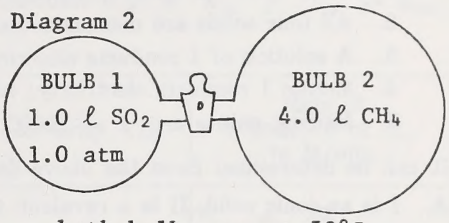
Use the diagrams below to answer items 6 and 7.

Diagram 1



both bulbs are at 50°C

Diagram 2



both bulbs are at 50°C

6. If the stopcock is opened in Diagram 1

   A. neither gas moves from its bulb

   B. neon moves into the left bulb at a slower rate than argon moves out

   C. after several hours the weight of the gases in the two bulbs is the same

   D. mixing occurs until the average speeds of the molecules of the two gases are equal

7. The same number of molecules of CH_4 as there are of SO_2 could be present in the system of Diagram 2 if the pressure of CH_4 is

   A. 4.0 atm

   B. 2.0 atm

   C. 1.0 atm

   D. 0.25 atm

---

8. Of the following elements, the one which is NOT diatomic is

   A. neon

   B. iodine

   C. fluorine

   D. nitrogen

9. A positively charged plate attracts

   A. positrons

   B. electrons

   C. alpha particles

   D. photons

10. Element X, which has the electron dot symbol $\cdot\ddot{\underset{\cdot}{X}}\cdot$, reacts with $Cl_{2(g)}$. The compound formed could be

    A. XCl

    B. XCl_2

    C. XCl_3

    D. XCl_4

Use the information below to answer items 11 to 13.

1. Four white, granular substances I, II, III and IV were tested.
2. All four solids are nonconductors of electricity.
3. A solution of I conducts electricity; a solution of III does not.
4. Molten I conducts electricity; molten II, III and IV do not.
5. Melting points are: I = 700°C, II = 53°C, III = 120°C, IV = 1800°C.

11. It can be determined from the above data that

A. I is an ionic solid, II is a covalent (network) solid

B. II and III could both be molecular solids

C. IV is the only metallic solid in the group

D. III could be an ionic solid

12. The particles occupying lattice positions are

A. in I, positive and negative ions

B. in II, positive kernels or cores of atoms

C. in III, atoms

D. in IV, giant, nonpolar molecules

13. The forces of attraction are

A. dipole-dipole attractions in I and III

B. covalent bonds in IV

C. van der Waal's forces in I and III

D. commonly shared valence electrons in II

---

14. Cathode ray tubes are used in

A. oscilloscopes

B. solid state stereos

C. transistor radios

D. walkie-talkies

15. A precipitate of AgCl is produced by the reaction between a $AgNO_3$ solution and a NaCl solution. The maximum amount of AgCl that would be made from 29.25 grams of NaCl is

A. 143.4 g

B. 84.80 g

C. 71.70 g

D. 29.25 g

16. When ethane, which costs 23¢ per 1000 cubic feet, is burned completely, 341 kcal/mole is produced. When methane, which costs 16¢ per 1000 cubic feet, is burned completely, 210 kcal/mole is produced. A comparison of the two fuels would be that

A. ethane is less expensive in terms of kcal per dollar cost

B. methane, CH_4, is a better fuel as it produces less $CO_{2(g)}$

C. ethane, C_2H_6, is a better fuel in terms of kcal per gram

D. methane would produce 1480 kcal per dollar cost

Use the information below to answer item 17.

The data from a reaction rate experiment with reaction $W_{(g)} + X_{(g)} + Y_{(g)} \rightleftharpoons Z_{(g)}$ is as follows:

Trial	Molarity $W_{(g)}$	Molarity $X_{(g)}$	Molarity $Y_{(g)}$	Rate of Formation of $Z_{(g)}$ in M/min
1	1	1	1	.02
2	2	2	1	.08
3	2	4	1	.16
4	2	4	2	.16
5	3	2	3	.12

17. The rate of the reaction is dependent upon

A. concentrations of reactants W and X

B. concentrations of reactants W and Y

C. concentrations of reactants W, X and Y

D. concentrations of reactants X and Y

---

18. Of the following reactions as written, the one which would NOT occur spontaneously at one molar concentration and 25°C is

A. $Cl_{2(g)} + 2Br^-_{(aq)} \rightarrow 2Cl^-_{(aq)} + Br_{2(g)}$

B. $Fe_{(s)} + 2Ag^+_{(aq)} \rightarrow Fe^{+2}_{(aq)} + 2Ag_{(s)}$

C. $2Na_{(s)} + Zn^{+2}_{(aq)} \rightarrow 2Na^+_{(aq)} + Zn_{(s)}$

D. $3Ni_{(s)} + 2Cr^{+3}_{(aq)} \rightarrow 3Ni^{+2}_{(aq)} + 2Cr_{(s)}$

19. When reacting, oxidizing agents become

A. oxidized, and increase in oxidation number

B. reduced, and increase in oxidation number

C. oxidized, and decrease in oxidation number

D. reduced, and decrease in oxidation number

20. Experimental analysis shows that an unknown organic compound quickly decolorizes an acidic $KMnO_4$ solution and reacts rapidly with sodium metal. Which of the structures below would BEST account for this behavior?

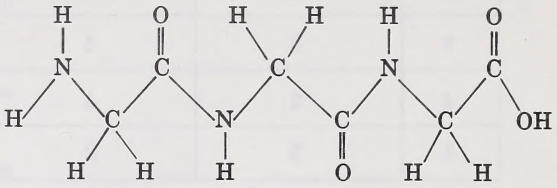
A. $CH_3 - \underset{\underset{O}{\|}}{C} - CH_3$

B. $\begin{matrix} CH_2 & - & CH & - & CH_2 \\ | & & | & & | \\ OH & & OH & & OH \end{matrix}$

C. CH_3CH_2COOH

D. CH_3CH_2CHO

21. In the formation below of the tripeptide molecule from three glycine molecules, the number of water molecules split out would be



A. 1

B. 2

C. 3

D. 4

22. The condition which would favour the formation of sulphur trioxide in the reaction,

$2SO_{2(g)} + O_{2(g)} \rightleftharpoons 2SO_{3(g)} + 47$ kcal, is

A. high pressure

B. high $[SO_3]$

C. high temperature

D. low $[O_2]$

23. Water is added to 25.0 g of sodium hydroxide to make 500 ml of solution. The resulting molarity of the NaOH solution is

A. $\frac{25.0}{0.500}$M

B. $\frac{25.0}{500}$M

C. $\frac{0.625}{0.500}$M

D. $\frac{25.0}{40.0}$M

24. The solubility expression for $Mg_3(PO_4)_{2(s)} \rightleftharpoons 3Mg^{+2}_{(aq)} + 2PO_4^{-3}{}_{(aq)}$ is

A. $K_{sp} = [Mg^{+2}]^3[PO_4^{-3}]^2$

B. $K_{sp} = \dfrac{[Mg^{+2}]^3[PO_4^{-3}]^3}{[Mg_3(PO_4)_2]}$

C. $K_{sp} = [Mg^{+2}][PO_4^{-3}]$

D. $K_{sp} = \dfrac{[Mg^{+2}]^3[PO_4^{-3}]^2}{[Mg_3(PO_4)_2]}$

25. A student was attempting to prepare some table salt by neutralization. On testing the solution, he found that red litmus turned blue. What should he do to complete the neutralization?

A. Add a few drops of acid and test again.

B. Add a few drops of base and test again.

C. Add a few drops of salt water to replace salt used up in testing.

D. Add nothing, the solution is neutral.

STOP! DO NOT proceed to Section B until instructed to do so.

You may recheck your responses to items in this Section in the time remaining.

When told to do so, turn to **SECTION B,** Page 8.

SECTION B

26. Element Z belongs to group IIA, element Y belongs to group VIIA. A possible compound formed between the two could be

A. ZY_3
B. Z_3Y_4
C. Z_2Y_3
D. ZY_2

27. Magnesium metal reacts with an acid. The gas released is

A. oxygen
B. nitrogen
C. neon
D. hydrogen

28. Substance 'X' has a melting point of 1200°C; substance 'Y' has a melting point of 1400°C. X and Y are combined to form a new substance. The new substance would most likely have a melting point which is

A. identical to that of X
B. identical to that of Y
C. different from both that of X and Y
D. the average of that of X and Y

29. Of the following procedures, the one which would most likely confirm a substance as being a compound would be

A. boiling
B. crystallizing
C. distilling
D. electrolysis

30. Y and Z are two closed rigid containers with the same volume. Container Y is filled with nitrogen gas and container Z is filled with hydrogen gas, both at room temperature and pressure. The ratio of the number of molecules of gas Y as compared to gas Z would be respectively

A. 1:1
B. 1:3
C. 14:1
D. 1:14

Use the information below to answer question 31.

Solid B reacts completely with solution A to produce a colored solution C. The following data are obtained.

weight of solution A	150.25 g
weight of solid B	11.50 g
weight of colored solution C	160.10 g

31. A possible explanation for the discrepancy in mass may be that

A. solids are more dense than liquids
B. solution A is an acid
C. a gas may have escaped
D. the colored solution has a smaller volume

32. The total number of moles of atoms in one mole of ammonium phosphate, $(NH_4)_3PO_4$, is

A. 4

B. 10

C. 13

D. 20

33. Assume the reaction represented by the balanced equation, $4HCl_{(g)} + O_{2(g)} \rightleftharpoons 2Cl_{2(g)} + 2H_2O_{(g)}$, has reached equilibrium. If the volume was suddenly halved at constant temperature, the mass would

A. remain constant for reactants and products

B. increase for reactants

C. increase for products

D. decrease for reactants and products

Use the information below to answer items 34 and 35.

While developing a useful model in attempting to understand some of the properties of molecules, a student listed the following.

1. If the electron attracting ability of the bonded atoms is identical the electron pair is equally shared and this bond is said to be nonpolar.
2. If the molecule contains only nonpolar bonds, the molecule is a nonpolar molecule.
3. If the electron attracting ability of the bonded atoms is different, the electron pair is not equally shared and this bond is said to be polar.
4. If a diatomic molecule contains a polar bond, the molecule is a dipole or a polar molecule.
5. If a triatomic or polyatomic molecule contains polar bonds, the molecule may or may not be polar. The shape of the molecule is one of the determining factors.

Choose one or more of the student's ideas needed to account for the experimentally determined data mentioned in each of the following items.

34. A thin stream of water, H_2O, is attracted to an electrically charged rod while a thin stream of carbon disulphide, CS_2, is not.

A. 1 and 2 only

B. 1 and 4 only

C. 3 and 5 only

D. 4 and 5 only

35. Hydrogen gas, H_2, does not exhibit any polar properties.

A. 4 only

B. 2 only

C. 1 and 4 only

D. 1 and 2 only

36. Two forms of element Z exist on planet T, ${}^{7}_{3}Z$ and ${}^{10}_{3}Z$. Both isotopes occur in equal quantities in nature. In the periodic table, the mass of one mole of Z atoms would be

A. 3.0 g

B. 7.0 g

C. 8.5 g

D. 10 g

37. Gases tend to condense when they are put under pressure. An explanation for this behavior is that

A. a lower average speed must result from high pressure

B. with the crowding of molecules, repulsive forces diminish

C. at high pressure, smaller average distances between molecules result in greater average attractive forces

D. at high pressure the molecules change shape and thus develop within them greater attractive forces

38. Asbestos, mica and granite are network (covalent) solids. All are silicates having roughly the same composition. Asbestos is fibrous; mica is thin layered; granite is a hard rock that is neither fibrous nor thin layered. A possible explanation for the difference is that silicates can

A. form molecules of varying sizes

B. pack lattice units in a variety of patterns

C. form silicon-oxygen bonds in varying strength

D. form silicon-silicon bonds of varying length

39. If a sphere with diameter of 200 meters (approximate length of 2 football fields) were considered an atom, the size of its nucleus could be similar in size to

A. one football field

B. a four storey apartment

C. a car

D. a pinhead

40. The equipment used to examine the internal (lattice) structures of crystals is

A. a cyclotron

B. a mass spectrometer

C. an electrolytic cell

D. x-ray diffraction equipment

41. On the basis of the equation, $CO_{(g)} + \frac{1}{2}O_{2(g)} \rightleftharpoons CO_{2(g)} + 67.6$ kcal, and assuming no change in temperature and pressure, one can correctly conclude that the

A. rate of reaction is rapid

B. moles of product and moles of reactants are the same

C. reaction is exothermic

D. weight of product is greater than weight of reactants

42. The voltage produced by a cell containing (Al/Al^{+3}) and (Sn/Sn^{+2}) both at one molar concentration and 25°C would be

A. 1.51 volts

B. 1.52 volts

C. 1.80 volts

D. 1.81 volts

43. Charge is carried within an electrolyte by

A. electrons

B. water molecules

C. protons

D. ions

Identify the process in the reactions mentioned in items 44 to 46.

1. saponification
2. esterification
3. hydrogenation
4. polymerization

44. The products of this reaction are glycerol and sodium stearate. The process is

A. 1

B. 2

C. 3

D. 4

45. In this reaction alcohol contributes an atom of hydrogen and the acid contributes a hydroxyl group to form water. The process is

A. 1

B. 2

C. 3

D. 4

46. In this reaction different amino acids unite, splitting out water molecules. The process is

A. 1

B. 2

C. 3

D. 4

---

47. Consider the reaction $(NH_4)_2CO_{3(s)} \rightleftharpoons NH_4HCO_{3(s)} + NH_{3(g)}$ at equilibrium. Suppose more $NH_4HCO_{3(s)}$ were added to the equilibrium mixture. The effect of this change on the system would be that

A. the equilibrium will shift to the reactants

B. the equilibrium will shift to the products

C. there will be no shift in the equilibrium

D. the concentration of $NH_{3(g)}$ will decrease

48. When 500 ml of 0.10M $AgNO_3$ is added to 500 ml of 0.20M NaCl at 25°C, the mass of precipitate formed would be

    A. 0.050 g

    B. 0.10 g

    C. 7.2 g

    D. 14 g

49. 60 ml of 0.25M H_3PO_4 are added to 140 ml of 0.750M H_3PO_4. The concentration of the resulting solution is

    A. 0.400M

    B. 0.600M

    C. 1.30M

    D. 2.00M

50. The number of milliliters of 0.050M $Ca(OH)_{2(aq)}$ that will be neutralized by 0.49 gram of H_2SO_4 dissolved to make 0.50 liter of solution is

    A. 4.9

    B. 15

    C. 1.0×10^2

    D. 2.0×10^2

STOP! DO NOT proceed to Section C until instructed to do so.

You may recheck your responses to items in this Section in the time remaining.

When told to do so, turn to **SECTION C,** Page 14.

SECTION C

51. The piece of equipment used to measure the average kinetic energy of the molecules of a liquid is a

A. thermometer
B. hydrometer
C. barometer
D. calorimeter

52. Element Z is in group VIA in the periodic table. Its most probable charge as a simple ion would be

A. +6
B. −6
C. +2
D. −2

53. A homogeneous gas sample was produced by combining 0.050 moles of oxygen, 0.015 moles of carbon dioxide, 0.005 moles of nitrogen and 0.005 moles of water vapor. If the measured pressure of the gas sample was found to be 125 mm of mercury at 20°C, the partial pressure contributed by the carbon dioxide gas is

A. 0.20 mm Hg
B. 0.30 mm Hg
C. 1.9 mm Hg
D. 25 mm Hg

54. When 112 grams of carbon monoxide are consumed according to the equation, $CO_{(g)} + \frac{1}{2}O_{2(g)} \rightleftharpoons CO_{2(g)} + 67.6$ kcal, which of the following occurs?

A. 1.00 mole of carbon monoxide is consumed.
B. 2.00 moles of oxygen are consumed.
C. 5.00 moles of carbon dioxide are produced.
D. 67.6 kcal of heat are generated.

Use the information below to answer items 55 and 56.

When methanol is vaporized and ignited it combines with oxygen to produce carbon dioxide gas and water vapor. Using the smallest whole number coefficients possible, balance the equation before answering the following questions.

$CH_3OH_{(g)} + O_{2(g)} \rightarrow CO_{2(g)} + H_2O_{(g)}$

55. The mass of carbon dioxide gas produced when 2.00 moles of methanol are consumed would be

A. 22.0 g
B. 44.0 g
C. 88.0 g
D. 176 g

56. If 8.0 moles of water vapor are formed, the number of moles of methanol required to produce this would be

A. 2.0
B. 4.0
C. 8.0
D. 12

57. One mole of molecules may be found in

A. 16 g of O_2

B. 16 g of CH_4

C. 14 g of N_2

D. 9.0 g of H_2O

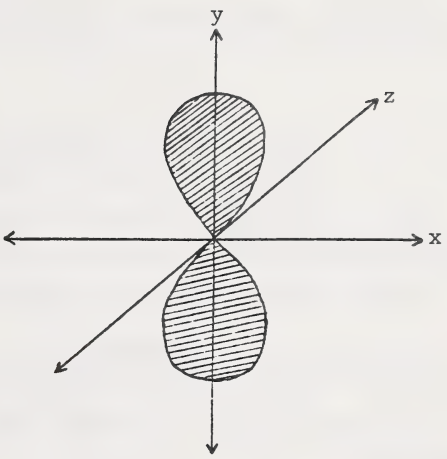
58. The atomic orbital which is represented in the diagram to the right is

A. an "s" orbital

B. a "p_x" orbital

C. a "p_y" orbital

D. a "p_z" orbital



59. A high energy beam removes 2 electrons from a neutral atom. The ion has a charge of

A. −2

B. −1

C. 0

D. +2

60. The statement about electrons in an atom that is NOT correct is that electrons

A. always occupy the same orbital

B. emit energy in moving from higher to lower energy levels

C. can only occupy definite energy levels

D. are attracted by the atomic nucleus

61. The element $^{16}_{7}M$ would have

A. 7 protons, 7 electrons, 9 neutrons

B. 7 protons, 9 electrons, 23 neutrons

C. 16 protons, 7 electrons, 16 neutrons

D. 7 protons, 7 electrons, 7 neutrons

62. On analysis, it was found that a sample of compound XY was covalently bonded. This would suggest that

A. X and Y could be in the same group

B. both X and Y should be transition elements

C. both X and Y are held together by electrostatic attraction

D. X and Y behave like inert elements

63. The products of the nuclear reaction $^{6}_{3}Li + {}^{1}_{0}n \rightarrow$ are

A. $^{4}_{2}He$ and $^{3}_{1}H$

B. $^{7}_{3}Li$ and $^{1}_{1}H$

C. $^{9}_{4}Be$ and $^{1}_{1}H$

D. $^{4}_{2}He$ and $^{2}_{1}H$

64. Dalton's atomic theory included the idea that

A. atoms are a combination of positive and negative matter

B. all atoms of a particular element are identical

C. negative electrons rotate about a positive nucleus

D. in chemical reactions atoms change their structure

65. Two gases X_2 and Y_2 react at STP. The balanced equation for the reaction is $X_{2(g)} + Y_{2(g)} \rightleftharpoons 2XY_{(g)} + 24$ kcal. The mass of one mole of X_2 is 40 grams. The mass of one mole of Y_2 is 25 grams. The number of kcal of heat produced if 100 grams of $Y_{2(g)}$ are consumed will be

A. 48

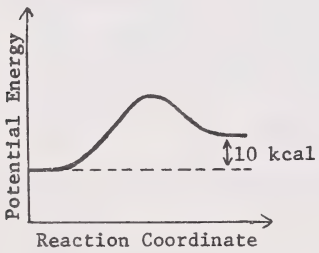
B. 96

C. 2.4×10^3

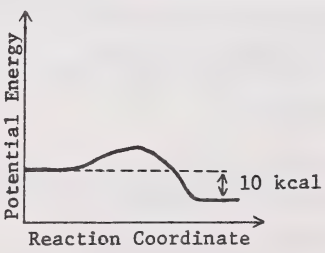
D. 4.8×10^3

66. A particular chemical reaction is found to be rather slow. A calorimetry experiment yields evidence which indicates that the reaction is slightly endothermic. Other evidence indicates that the reaction occurs spontaneously. The graph which most accurately represents the reaction is

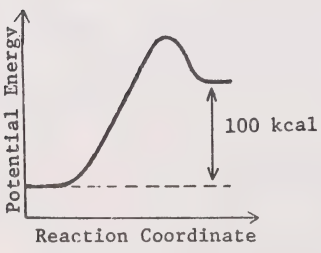
A.



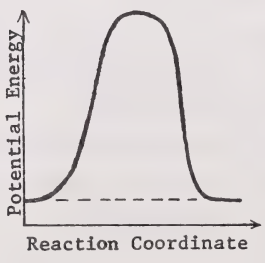
B.



C.



D.



67. During the electroplating of silver, the aqueous silver ions are

A. reduced at the cathode

B. reduced at the anode

C. oxidized at the cathode

D. oxidized at the anode

68. The abnormally high boiling point of glycerol ($CH_2OHCHOHCH_2OH$) is primarily due to

A. complexity of the molecules

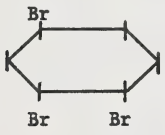
B. high degree of hydrogen bonding

C. large number of double bonds in the molecules

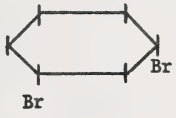
D. size of the molecules

69. The structural formula for the molecule which is formed as a result of the addition of bromine gas to cyclohexene is

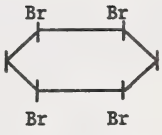
A.



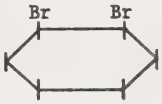
B.



C.



D.



70. Experiments have shown that the bond in hydrogen fluoride is more polar than that in hydrogen iodide. This could suggest that

A. hydrogen behaves like a metal in hydrogen iodide

B. hydrogen attracts electrons more strongly than fluorine

C. iodine exhibits stronger nonmetallic properties than fluorine

D. the valence electrons in fluorine are closer to the nucleus than those in iodine

71. For the reaction represented by the balanced equation, $4HCl_{(g)} + O_{2(g)} \rightleftharpoons 2Cl_{2(g)} + 2H_2O_{(g)}$, the law of chemical equilibrium (K_{eq}) is

A. $\dfrac{[4HCl][O_2]}{[2Cl_2][2H_2O]}$

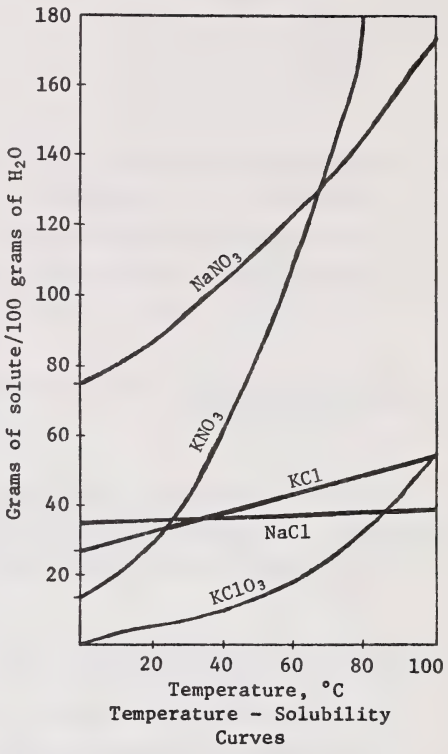
B. $\dfrac{[HCl]^4[O_2]}{[Cl_2]^2[H_2O]^2}$

C. $\dfrac{[2Cl_2][2H_2O]}{[4HCl][O_2]}$

D. $\dfrac{[Cl_2]^2[H_2O]}{[HCl]^4[O_2]}$

Use the information and graph below to answer items 72 and 73.

After a number of quantitative experiments to establish the solubility curves for various chemical compounds, a student was able to plot his results on the graph to the right.



Temperature - Solubility Curves

72. The compound which shows the greatest increase in solubility (grams of solute per 100 grams of H_2O) for the temperature range indicated would be

A. $KClO_3$

B. KNO_3

C. $NaNO_3$

D. KCl

73. The compound which shows the least increase in solubility (grams of solute per 100 grams of H_2O) for the temperature range indicated would be

A. NaCl

B. KCl

C. $KClO_3$

D. KNO_3

---

74. A student suspects that an unkown acid of known concentration is diprotic. In order to test this hypothesis, the most useful test would be

A. pH determination using indicators

B. titration with a known concentration of NaOH

C. molecular weight determination

D. degree of electrical conductivity

75. The student further suspects that the tested acid in item 74 is H_2CO_3. In order to confirm this, the most useful solution would be

A. $NaCl_{(aq)}$

B. $Ba(OH)_{2(aq)}$

C. $Li_2S_{(aq)}$

D. $K_2SO_{4(aq)}$

You may recheck your responses to items in this Section in the time remaining.

LB 3054 C2 D392A
CHEMISTRY ACHIEVEMENT TEST --

NL 39946555 CURR HIST

000024816076

DATE DUE SLIP

F255